

# **Nosocomial Infections: Definitions**

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# **What is a Nosocomial Infection ?**

- **An infection which is acquired during hospitalization and which was not present or incubating at the time of admission**
- **An infection which is acquired in the hospital and becomes evident after discharge from the hospital**
- **A newborn infection which is the result of passage through the birth canal**

# **What is a Nosocomial Infection ?**

**Practically - to establish that an infection is hospital acquired,**

**SHOW THAT the patient:**

- 1. HAS AN INFECTION, not a simple colonization**
- 2. WAS NOT infected at the time of admission**
- 3. HAD SUFFICIENT TIME to develop infection**

# True Infection NOT Colonization



- **Infections are accompanied by signs and symptoms:**
  - → fever, malaise
  - → in localized infections: swelling due to inflammation, heat, pain, erythema (tumor, dolor, rubor, calor)
- **Use definitions which establish minimum characteristics for infection**
- **Remember:** Immunocompromised patients do not show signs of infection as normal patients. Neutropenic patients ( $\leq 500$  neutrophils /mm<sup>3</sup>) show no pyuria, no purulent sputum, little infiltrate and no large consolidation on chest X-ray

# NO Infection at Time of Admission

# 2

- **establish prior negativity**
- **check history, symptoms and signs**
- **documented at time of admission, lab tests & chest X-rays done**
  - normal physical examination
  - absence of signs and symptoms
  - normal chest X-ray
  - negative culture or lack of culture

**Example: If urine cultures are collected at day 7 of hospitalization and none was collected before, it implies that no signs of infection were present in urine before**

# Sufficient Time to Develop Infection

## 3

- diseases with specific incubation period: stay in hospital  $\geq$  incubation period
- numerous infections do not have well set incubation periods (for example, staphylococci, *E.coli* infections)
  - these infections rarely develop in less than **2 days**

**To establish a nosocomial infection, meeting the definition criteria is sufficient. There is no need to have proof *beyond the shadow of a doubt.***

# Case Definitions

AJIC major articles

## CDC/NHSN surveillance definition of health care–associated infection and criteria for specific types of infections in the acute care setting

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### BACKGROUND

Since 1988, the Centers for Disease Control and Prevention (CDC) has published 2 articles in which nosocomial infection and criteria for specific types of nosocomial infection for surveillance purposes for use in acute care settings have been defined.<sup>1,2</sup> This document replaces those articles, which are now considered obsolete, and uses the generic term “health care–associated infection” or “HAI” instead of “nosocomial.” This document reflects the elimination of criterion 1 of clinical sepsis (effective in National Healthcare Safety Network [NHSN] facilities since January 2005) and criteria for laboratory–confirmed bloodstream infection (LCBI). Specifically for LCBI, criterion 2c and 3c, and 2b and 3b, were removed effective in NHSN facilities since January 2005 and January 2006, respectively. The definition of “implant,” which is part of the surgical site infection (SSI) criteria, has been slightly modified. No other infection criteria have been added, removed, or changed. There are also notes throughout this document that reflect changes in the use of surveillance criteria since the implementation of NHSN. For example, the

population for which clinical sepsis is used has been restricted to patients  $\leq 1$  year old. Another example is that incisional SSI descriptions have been expanded to specify whether an SSI affects the primary or a secondary incision following operative procedures in which more than 1 incision is made. For additional information about how these criteria are used for NHSN surveillance, refer to the *NHSN Manual: Patient Safety Component Protocol* available at the NHSN Web site ([www.cdc.gov/nhsn/dhqp.html](http://www.cdc.gov/nhsn/dhqp.html)). Whenever revisions occur, they will be published and made available at the NHSN Web site.

### CDC/NHSN SURVEILLANCE DEFINITION OF HEALTH CARE–ASSOCIATED INFECTION

For the purposes of NHSN surveillance in the acute care setting, the CDC defines an HAI as a localized or systemic condition resulting from an adverse reaction to the presence of an infectious agent(s) or its toxin(s). There must be no evidence that the infection was present or incubating at the time of admission to the acute care setting.

HAIs may be caused by infectious agents from endogenous or exogenous sources.

- Endogenous sources are body sites, such as the skin, nose, mouth, gastrointestinal (GI) tract, or vagina that are normally inhabited by microorganisms.
- Exogenous sources are those external to the patient, such as patient care personnel, visitors, patient care equipment, medical devices, or the health care environment.

Other important considerations include the following:

- Clinical evidence may be derived from direct observation of the infection site (eg, a wound) or

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# The 4 Big Ones



- **BSI Bloodstream infection**
  - **LCBI Laboratory-confirmed bloodstream infection**
  - **CSEP Clinical sepsis**
- **PNEU Pneumonia**
  - **PNU1 Clinically defined pneumonia**
  - **PNU2 Pneumonia with specific laboratory findings**
  - **PNU3 Pneumonia in immunocompromised patient**
- **UTI Urinary tract infection**
  - **SUTI Symptomatic urinary tract infection**
  - **ASB Asymptomatic bacteriuria**
  - **OUTI Other infections of the urinary tract**
- **SSI Surgical site infection**
  - **SIP Superficial incisional primary SSI**
  - **SIS Superficial incisional secondary SSI**
  - **DIP Deep incisional primary SSI**
  - **DIS Deep incisional secondary SSI**
  - **Organ/space Organ/space SSI. Indicate**

# **Blood Stream Infections BSI**

# **Primary Lab Confirmed BSI 1 - Pathogen**

- **Recognized pathogen from 1 or more blood culture**
- **Not related to infection at other site**
- **Any age**

# Lab Confirmed BSI

## 2 – Contaminant\*

- **One of following:**
  - fever  $>38^{\circ}\text{C}$
  - or chills
  - or hypotension  $<90$  mm
- **Not related to another infection**
- **AND Common skin contaminant**
  - from 2 or more blood cultures
  - drawn on separate occasions

- diphtheroids
- *Corynebacterium* spp
- *Bacillus* [not anthracis] spp
- *Propionibacterium* spp
- Coagulase-negative staphylococci [including *S. epidermidis*]
- Viridans group streptococci
- *Aerococcus* spp
- *Micrococcus* spp

# **Lab Confirmed BSI**

## **3 - Pediatric**

- **One of following:**
  - **fever  $>38^{\circ}\text{C}$  rectal**
  - **or hypothermia  $<37^{\circ}\text{C}$**
  - **or apnea**
  - **or bradycardia**
- **Not related to another infection**
- **AND Common skin contaminant**
  - **from 2 or more blood cultures**
  - **drawn on separate occasions**

# Clinical Sepsis: Neonate, Infant

- **Age  $\leq$  1 year old**
- **One of following:**
  - **Fever  $>38^{\circ}\text{C}$  rectal**
  - **or hypothermia  $<37^{\circ}\text{C}$**
  - **or apnea**
  - **or bradycardia**
- **AND no blood culture or negative blood culture**
- **AND no infection related to other site**
- **AND Tx ordered for sepsis**

# **Surgical Site Infection SSI**

# Clean/Contaminated

- **Clean site:**
  - **No inflammation**
  - **No penetration**
  - **Closed or with closed drainage**
- **Clean Contaminated site:**
  - **Respiratory, GI, genital or urinary tracts entered under controlled conditions with no unusual contamination**
  - **Specific site: biliary tract, appendix, vaginal, oropharynx**

# Clean/Contaminated Cont.

- **Contaminated site:**
  - **Accidental wound with major breach in asepsis**
  - **Wound with massive GI spill**
  - **Sites entered with urinary, biliary infection, acute non-purulent infection**
- **Dirty & Infected:**
  - **Old wound with devitalized tissue, foreign bodies, fecal contamination**
  - **Perforated viscus**
  - **Pus**

# Classification

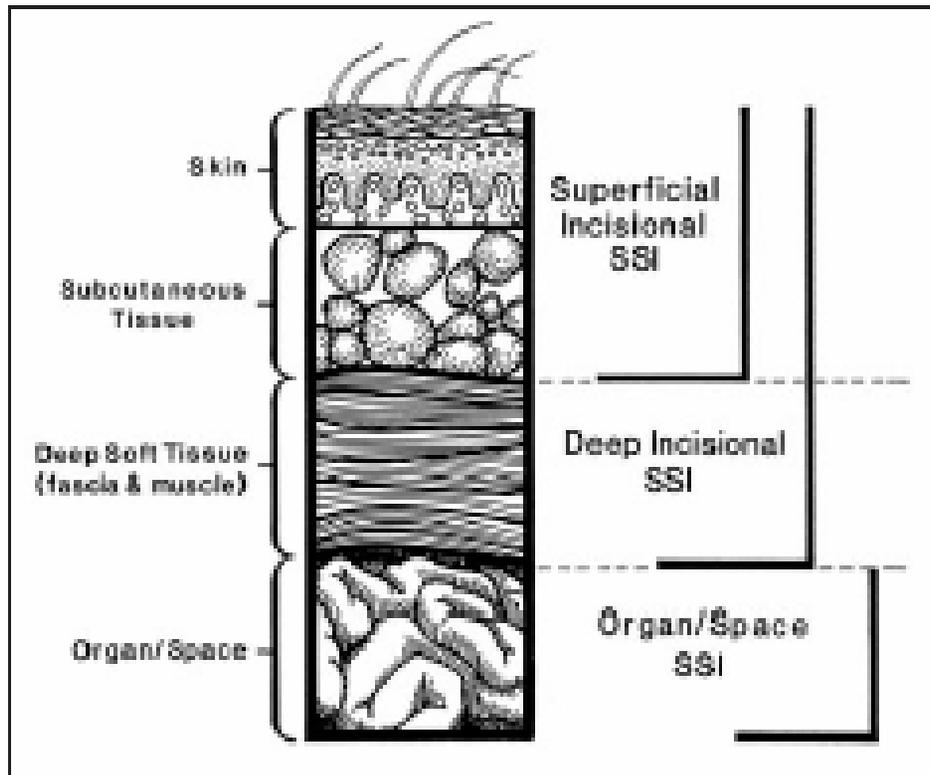


FIGURE. Cross-section of abdominal wall depicting CDC classifications of surgical site infection.<sup>22</sup>

**Infection occurs within 30 days after the operation if no implant is left in place**

**or**

**within 1 year if implant is in place and the infection appears to be related to the operation**

# Superficial SSI

- **PURULENT DRAINAGE from superficial incision (Culture not indispensable)**

**or**

- **Positive culture from a closed surgical site obtained aseptically**

**or**

- **One of : Pain or tenderness, localized swelling, redness, heat, wound dehiscence, abscess and of infection and wound reopening**

**or**

- **Medical diagnosis of SSI**

## **Not Superficial SSI**

**Stitch abscess**

**Episiotomy, circumcision infection  
(not operative figures)**

**Infected burn wound**

## **Deep Incisional SSI**

**Infection involves deep soft tissues (e.g., facial and muscle layers)**

***and* at least *one* of the following:**

- 1. Purulent drainage from deep incision but not from organ/space**
- 2. Deep incision dehiscence or opened by surgeon when patient has at least one of: fever ( $>38^{\circ}\text{C}$ ), localized pain, or tenderness, unless site is culture-negative**
- 3. Abscess or other evidence of infection of deep incision on direct examination, re-operation, histopathologic or radiologic exam**
- 4. Diagnosis of a deep incisional SSI by physician**

- Report infection that involves both superficial and deep incision sites as deep incisional SSI**
- Report an organ/space SSI that drains through the incision as a deep incisional SSI**

# Organ /Space SSI

**Infection involves organs or spaces (other than incision) opened or manipulated during an operation**

***and* at least *one* of the following:**

- **1. Purulent drainage from a drain that is placed through a stab wound into the organ/space**
- **2. Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space**
- **3. An abscess or other evidence of infection organ/space on direct examination, re-operation, histopathologic or radiologic examination**
- **4. Diagnosis of an organ/space SSI by physician.**

# Organ / Space SSI Specific Type

- **BONE**
- **BRST**
- **CARD**
- **DISC**
- **EAR**
- **EMET**
- **ENDO**
- **EYE**
- **GIT**
- **IAB**
- **IC**
- **JNT**
- **LUNG**
- **MED**
- **MEN**
- **ORAL**
- **OREP**
- **OUTI**
- **SA**
- **SINU**
- **UR**
- **VASC**
- **VCUF**

# **Urinary Tract Infection UTI**

# Asymptomatic Bacteriuria -1-

- **Patient with indwelling urinary catheter within 7 days before first culture**

**and**

- **Positive urine culture  $\geq 10^5$  microorganisms per mL with no more than two species of microorganisms**

**$10^5 = 100,000$**

**and**

- **Patient has no fever ( $\leq 38^\circ\text{C}$ ), urgency, frequency, dysuria, or suprapubic tenderness**

## **Asymptomatic Bacteriuria -2-**

- **Patient with NO indwelling urinary catheter within 7 days before first culture**

**and**

- **Patient with at least 2 positive urine cultures  $\geq 10^5$  microorganisms /mL of urine with repeated isolation of same microorganism**

**and**

- **no more than two species of microorganisms**

**and**

- **Patient has no fever ( $\leq 38^\circ\text{C}$ ), urgency, frequency, dysuria, or suprapubic tenderness**

# **Symptomatic UTI -1-**

- **Patient has at least one of the following signs or symptoms with no other recognized cause:  
fever ( $\geq 38^{\circ}\text{C}$ ), urgency, frequency, dysuria,  
suprapubic tenderness**

**and at least 1 of the following:**

- **Positive urine culture  $\geq 10^5$  microorganisms per mL  
with no more than two species of microorganisms**

## **Symptomatic UTI -2-**

- **Patient has at least 2 of the following signs or symptoms with no other recognized cause:**
  - fever ( $\geq 38^{\circ}\text{C}$ ), urgency, frequency, dysuria, suprapubic tenderness**
- and at least 1 of the following:**
- **Positive dipstick for leukocyte esterase or nitrate**
- **Pyuria (urine with  $\geq 10$  wbc/mm<sup>3</sup> or  $\geq 3$  wbc/HPF unspun urine)**
- **Microorganisms seen on Gram stain of unspun urine**
- **At least 2 urine cultures with repeated isolation of same uropathogen (G neg bacteria or *S. saprophyticus*) with  $\geq 10^2$  colonies/mL in non-voided specimens**
- **$\leq 10^5$  colonies/ml of single uropathogen (G neg bacteria or *S. saprophyticus*) in patient treated with UTI antimicrobial**
- **Physician diagnosis of UTI**
- **Physician institutes Tx for UTI**

## **Symptomatic UTI -3- Pediatrics**

- **Patient  $\leq 1$  year of age with at least one of the following signs or symptoms with no other recognized cause:  
fever ( $\geq 38^{\circ}\text{C}$ ), hypothermia ( $\leq 37^{\circ}\text{C}$ ), apnea, bradycardia, dysuria, lethargy, or vomiting**

**and at least 1 of the following:**

- **Positive urine culture  $\geq 10^5$  microorganisms per mL with no more than two species of microorganisms**

# Symptomatic UTI -4- Pediatrics

- **Patient <1 year of age with at least one of the following signs or symptoms with no other recognized cause:**
  - fever ( $\geq 38^{\circ}\text{C}$ ), hypothermia ( $\leq 37^{\circ}\text{C}$ ), apnea, bradycardia, dysuria, lethargy, or vomiting**
- **and at least 1 of the following:**
- **Positive dipstick for leukocyte esterase or nitrate**
- **Pyuria (urine with  $\geq 10$  wbc/mm<sup>3</sup> or  $\geq 3$  wbc/HPF unspun urine)**
- **Microorganisms seen on Gram stain of unspun urine**
- **At least 2 urine cultures with repeated isolation of same uropathogen ( G neg bacteria or *S. saprophyticus*) with  $\geq 10^2$  colonies/mL in non-voided specimens**
- **$\leq 10^5$  colonies/ml of single uropathogen (G neg bacteria or *S. saprophyticus*) in patient treated with UTI antimicrobial**
- **Physician diagnosis of UTI**
- **Physician institutes Tx for UTI**

## **Symptomatic UTI - 5**

- **Positive culture of urinary catheter tip not acceptable laboratory test to diagnose UTI**
- **Urine cultures must be obtained using appropriate technique**
  - **Adult: clean catch collection or catheterization**
  - **Infants: bladder catheterization or suprapubic aspiration**
- **Positive urine culture from bag is unreliable and should be confirmed**

# **Pneumonia**

# Pneumonia

- **Physician dx of pneumonia NOT sufficient**
  - **Sensitive BUT NOT specific**
  - **Poor correlation with autopsy**
- **Histo and culture of lung tissue remain gold standard**
- **Drug reactions, myocardial infarction, congestive heart failure, pulmonary embolism, atelectasis, COPD, RDS, chemical aspiration, mimic HAI pneumonia**
- **Difficult to determine in elderly, infants, immunocompromised**

# Pneumonia Bacteriology

- **Sputum cultures and endotracheal aspirates do NOT reliably identify pathogens**
- **Better are:**
  - **Protected Specimen brush (PSB)**
  - **Broncho-Alveolar Lavage (BAL)**
  - **Protected Broncho-Alveolar Lavage (PBAL)**
- **Early onset: First 4 days of hospitalization**
  - ***Moraxella, H. influenzae, S. pneumoniae*, viruses**
- **Late onset: After 4<sup>th</sup> day**
  - **Staph, MRSA, Gram Neg rods, viruses, Legionella, fungi, Pneumocystis**

# Ventilator Associated Pneumonia

- **Pneumonia**
- **Following within 48 hours ventilator to assist or control respiration continuously through**
  - **Tracheostomy or**
  - **Endotracheal intubation**

# **Pneumonia Definition: 1-Xray**

- **Patient has 1 or 2 chest X-rays with**
  - **New or progressive AND persistent infiltrate,**
  - **Consolidation,**
  - **Cavitation,**
  - **Pneumatoceles (age  $\leq$  1 y.o.)**
- **Patient without underlying disease: 1 Xray**
- **Patient with underlying disease: 2 Xrays**

## **Pneumonia Definition: 2-Basic Clinical**

- **Patient has at least one of**
  - **Fever ( $>38^{\circ}\text{C}$  /  $100.4^{\circ}\text{F}$ ) with no recognized cause**
  - **Leukopenia ( $\leq 4,000$  WBC) or leukocytosis ( $\geq 15,000$  WBC) and left shift ( $\geq 10\%$  band forms)**
  - **Altered mental status (Age  $\geq 70$  y.o.)**

## **Pneumonia Definition: 3-Basic Clinical**

- **Patient has at least one of**
  - **New onset purulent sputum or change in sputum character or ↑ respiratory secretions or ↑ suctioning requirements or**
  - **New onset or worsening cough or dyspnea or tachypnea or**
  - **Rales or bronchial breath sounds or**
  - **Worsening gas exchanges**

# **Pneumonia Definition:**

## **4- Clinical ImmunoComp Expansion**

### **BASIC CLINICAL 2**

- **Patient has at least one of**
  - **New onset purulent sputum or change in sputum character or ↑ respiratory secretions or ↑ suctioning requirements or**
  - **New onset or worsening cough or dyspnea or tachypnea or**
  - **Rales or bronchial breath sounds or**
  - **Worsening gas exchanges**

### **or EXPANDED CLINICAL**

#### **At least one of these**

- **Altered mental status with no other cause: Age  $\geq$  70 y.o.**
- **Hemoptysis**
- **Pleuritic chest pain**

# **Pneumonia Definition 5-Clinical Infant**

- **Age  $\leq$  1 y.o.**
- **Worsening gas exchanges**

**And 3 of the following**

- **Temperature instability with no other cause**
- **Leukopenia ( $\leq$  4,000 WBC) or leukocytosis ( $\geq$ 15,000 WBC) and left shift ( $\geq$ 10% band forms)**
- **New onset purulent sputum or change in sputum character or  $\uparrow$  respiratory secretions or  $\uparrow$  suctioning requirements**
- **Apnea, tachypnea, nasal flaring with retraction of chest wall or grunting**
- **Wheezing, rales or rhonchi**
- **Cough**
- **Bradycardia ( $<$ 100 /mn) or tachycardia ( $>$ 170 /mn)**

# **Pneumonia Definition**

## **6-Clinical Children**

- **Age >1 y.o. and ≤ 12 y.o.**
- **Fever (>38.4°C / 101.1°F) or hypothermia (<36.5°C / 97.7°F) with no recognized cause**
- **Leukopenia (≤ 4,000 WBC) or leukocytosis (≥15,000 WBC) and left shift (≥10% band forms)**
- **New onset purulent sputum or change in sputum character or ↑ respiratory secretions or ↑ suctioning requirements**
- **Rales or bronchial breath sounds**
- **Worsening gas exchanges**

# **Pneumonia Definition: 7-Lab Confirmation Common Pathogens**

- **at least 1 of the following:**
  - **Organisms cultured from blood not related to another infection**
  - **Positive pleural fluid culture**
  - **Positive quantitative culture from protected specimen (transtracheal aspirate, bronchial brushing, or biopsy)**
  - **≥5% BAL obtained cells with intra-cellular bacteria on microscopic exam**
  - **Histopathologic evidence of**
    - **Abscess, consolidation,**
    - **Positive quantitative culture**
    - **Lung invasion by fungal hyphae**

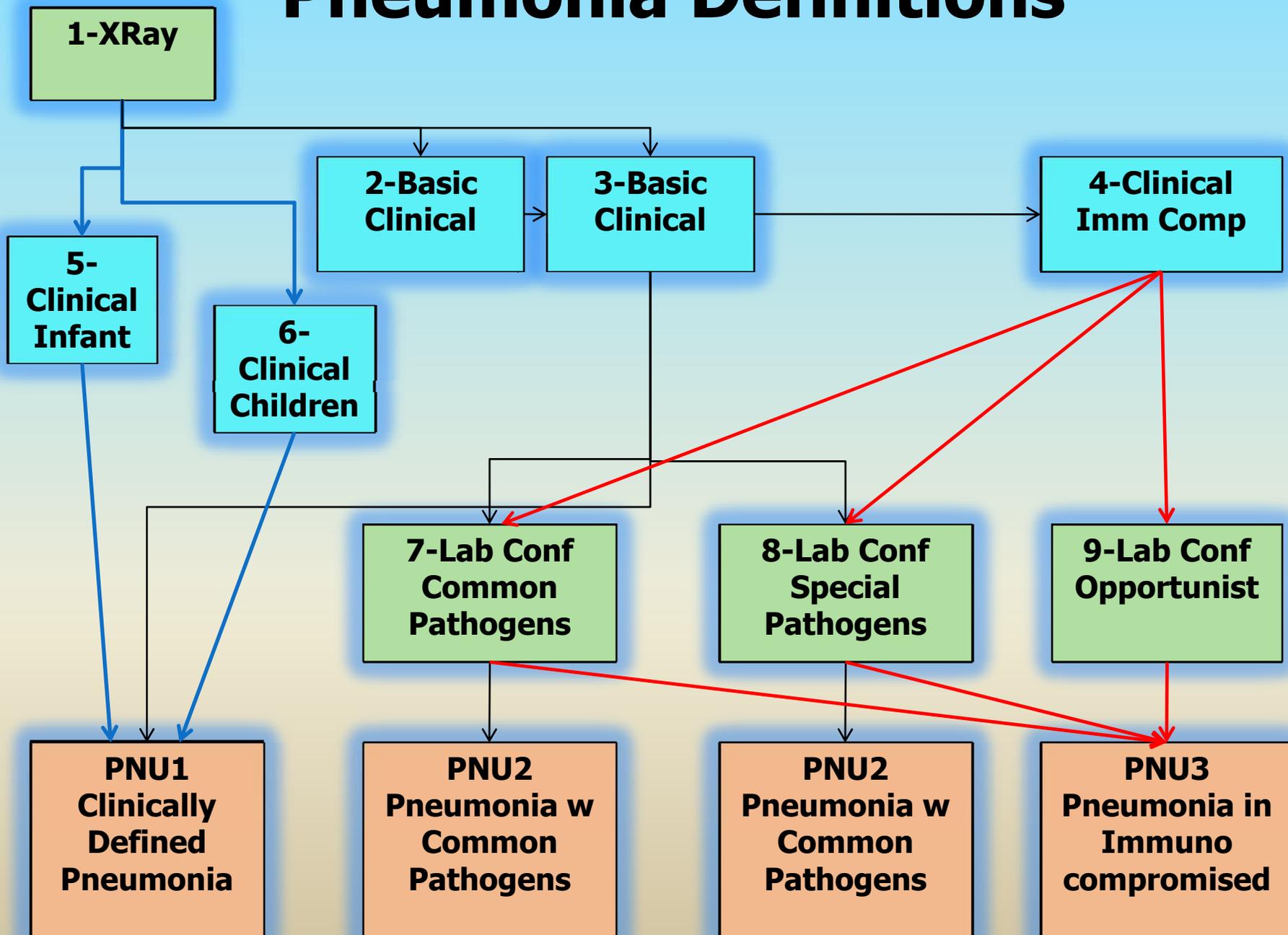
# **Pneumonia Definition: 8-Lab Confirmation Special Pathogens**

- **at least 1 of the following:**
  - **Positive culture for virus or chlamydia from respiratory secretions**
  - **Positive detection of viral antigen from respiratory secretions**
  - **4 fold rise in paired sera (IgG) for pathogens**
  - **Positive PCR for Chlamydia or Mycoplasma**
  - **Positive micro-IF test for Chlamydia**
  - **Positive culture or micro-IF for Legionella**
  - **Detection of Legionella pn serogroup 1 antigens in urine by RIA or EIA**
  - **4 fold rise in Legionella pn antibody titer to  $\geq 128$  in paired sera**

# **Pneumonia Definition: 9-Lab Confirmation Opportunistic**

- **at least 1 of the following:**
  - **Matching blood and sputum cultures for *Candida* spp**
  - **Evidence of fungi or *Pneumocystis carinii* from protected specimens**
    - **Microscopy**
    - **Positive culture of fungi**

# Pneumonia Definitions



# Other Infections

- **BJ Bone and joint infection**
  - **BONE Osteomyelitis**
  - **JNT Joint or bursa**
  - **DISC Disc space**
  
- **CNS Central Nervous System**
  - **IC Intracranial infection**
  - **MEN Meningitis or ventriculitis**
  - **SA Spinal abscess without meningitis**

# Other Infections

- **CVS Cardiovascular System Infection**
  - **VASC Arterial or venous infection**
  - **ENDO Endocarditis**
  - **CARD Myocarditis or pericarditis**
  - **MED Mediastinitis**
- **EENT Eye, ear, nose, throat, or mouth infection**
  - **CONJ Conjunctivitis**
  - **EYE Eye, other than conjunctivitis**
  - **EAR Ear, mastoid**
  - **ORAL Oral cavity (mouth, tongue, or gums)**
  - **SINU Sinusitis**
  - **UR Upper respiratory tract, pharyngitis, laryngitis, epiglottitis**

# Other Infections

- **GI Gastrointestinal system infection**
  - **GE Gastroenteritis**
  - **GIT Gastrointestinal (GI) tract**
  - **HEP Hepatitis**
  - **IAB Intraabdominal, not specified elsewhere**
  - **NEC Necrotizing enterocolitis**
- **LRI Lower respiratory tract infection, other than pneumonia**
  - **BRON Bronchitis, tracheobronchitis, tracheitis, without evidence of pneumonia**
  - **LUNG Other infections of the lower respiratory tract**

# Other Infections

- **REPR Reproductive tract infection**
  - **EMET Endometritis**
  - **EPIS Episiotomy**
  - **VCUF Vaginal cuff**
  - **OREP Other infections of the male or female reproductive tract**

# Other Infections

- **SST Skin and soft tissue infection**
  - **SKIN Skin**
  - **ST Soft tissue**
  - **DECU Decubitus ulcer**
  - **BURN Burn**
  - **BRST Breast abscess or mastitis**
  - **UMB Omphalitis**
  - **PUST Pustulosis**
  - **CIRC Newborn circumcision**
- **SYS Systemic Infection**
  - **DI Disseminated infection**